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MY NASA DATA: Sea Surface Temperature Trends of the Gulf Stream
http://mynasadata.larc.nasa.gov/lesson-plans/?page_id=474?&passid=13

Sea Surface Temperature Trends of the Gulf Stream

Purpose: Students will use authentic satellite data to explore the seasonal changes in sea surface temperature of the Gulf Stream.

Grade Level: 6 – 12

Estimated Time for Completing Activity: One 50-minute class period

Learning Outcomes:

- Students will be able to understand and explain the importance of the Gulf Stream
- Students will be able to explore real satellite data and construct graphs for analysis

Prerequisite

- Familiarity with accessing websites on the Internet
- Familiarity with locating geographical positions on a map
- Familiarity with producing graphs in Excel

Tools

- Computer with Internet access
- Spreadsheet program
- Atlas or Globe

National Standards:

Science Content: A Science as Inquiry

Science Content: D Earth and Space Science

Science Content: E Science and Technology

AP Environmental Science Topics

Atmosphere-ocean interactions

Energy

Ocean circulation

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Virginia Standards of Learning:

ES.2c: The student will demonstrate scientific reasoning and logic by comparing different scientific explanations for a set of observations about the Earth.

ES.3: The student will investigate and understand how to read and interpret maps, globes, models, charts, and imagery.

PS.7: The student will investigate and understand temperature scales, heat, and heat transfer. Key concepts include Celsius and Kelvin temperature scales and absolute zero.

Sci6.3: The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere, and on the Earth's surface.

Sci6.5: The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment.

Vocabulary:

[conduction](#)

[convection](#)

[coordinates](#)

[evaporation](#)

[Gulf Stream](#)

[latent heat](#)

[latitude](#)

[longitude](#)

[MCSST](#)

[radiation](#)

[sea surface temperature](#)

Lesson Links:

[Example SST Plot](#)

[What Causes the Gulf Stream?](#)

[Live Access Server](#)

[Example Excel line plot](#)

[Article: Sources of the Mild Climate of Europe](#)

[Opening MY NASA DATA Microsets in Microsoft Excel](#)

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Background:

Intense incoming solar radiation of the Sun is continuously entering into the vast tropical oceans of the Earth. The energy enters these water bodies at the surface when absorbed radiation is converted into heat energy. The warmed surface water is then transferred downward by conduction and convection to form a mixed surface layer of increased temperature. The horizontal transfer (balance) of this heat energy from the Equator to the poles is accomplished by ocean currents.

One of the most studied and important ocean currents of the world lies along the eastern coast of the United States and is called the Gulf Stream. It derives its name from its source region of warm water in the Gulf of Mexico. The Gulf Stream transports enormous amounts of heat from the Gulf of Mexico northward along the East Coast, and then northeastward toward Europe. Along the way, it warms the overlying atmosphere, transferring much of its heat energy through the process of evaporation. The latent heat energy (released as the warm air rises and condenses) can fuel interesting weather events such as East Coast snowstorms and hurricanes, and provide milder winters for the high latitudes of Europe.

The evaporative process also causes the cooling surface waters arriving in the North Atlantic to become increasingly salty and dense enough to sink. The water then flows back southward toward the tropics along the bottom of the Atlantic Basin. This overturning is part of a global pattern of ocean circulation driven by winds and the exchange of heat and water vapor at the sea surface. It is believed that any small changes to this circulation will have significant effects on global climate.

For the past two decades, scientists have been collecting sea surface temperature (SST) data from satellites, buoys and ships in the Gulf Stream and Atlantic Basin. In this lesson, you will gain access to the data used to monitor these weather and climate effects. The data are collected by a NOAA satellite instrument called the Advanced Very High Resolution Radiometer (AVHRR) and are combined with other observations to create a product called the Multi-Channel Sea Surface Temperature (MCSST).

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Procedure:

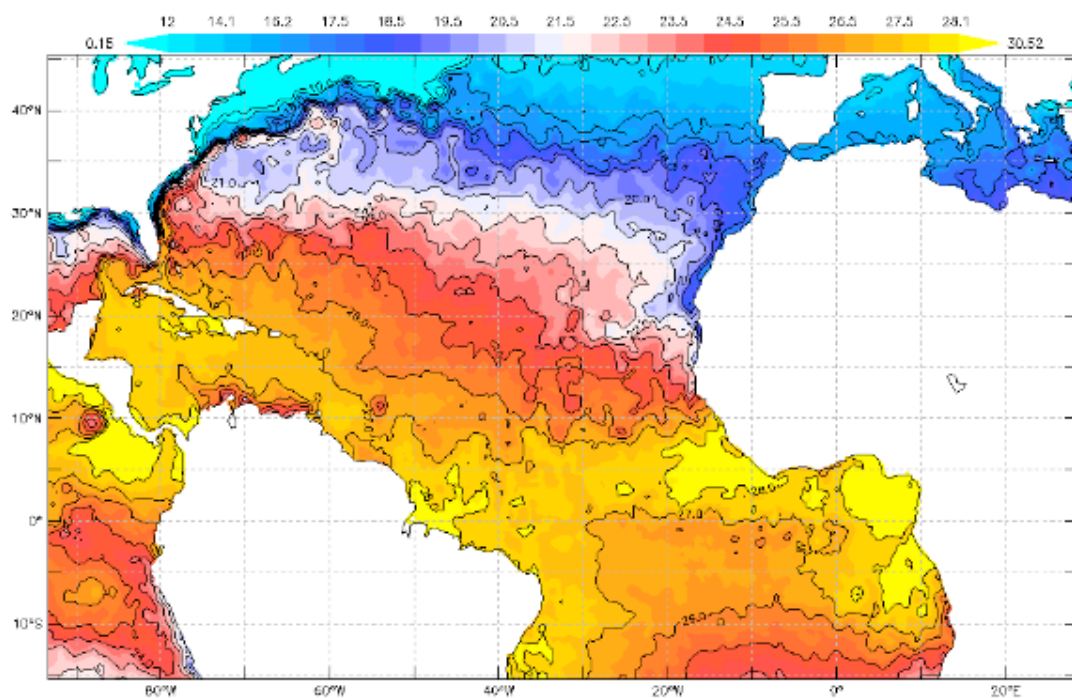
Pre-Lesson Inquiry Activity:

Pre-lesson inquiry activity: Have students write hypotheses about (1) the effects of the Gulf Stream on coastal water temperatures and (2) the effects of the Gulf Stream on the fishing industry

Part 1:

Students will explore the Live Access Server (LAS) and produce plots of sea surface temperature. An example plot of SST for the Gulf Stream is provided above.

Plot 1 –Daily Sea Surface Temperature (GHR SST) in degrees Celsius For Jan 15, 2014

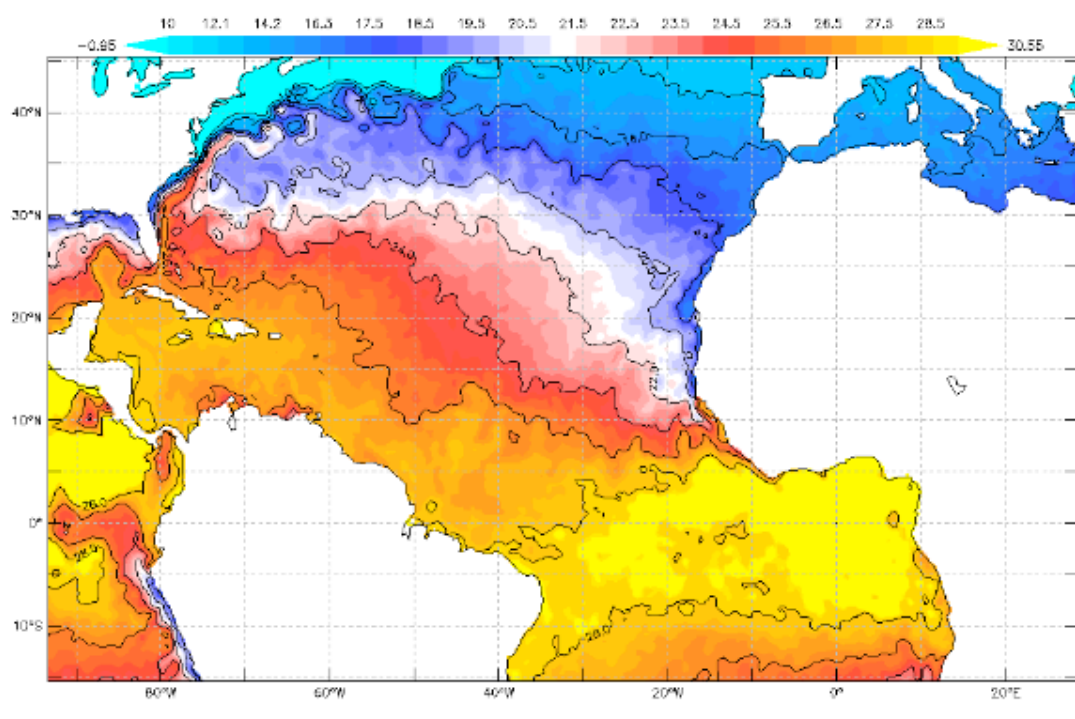


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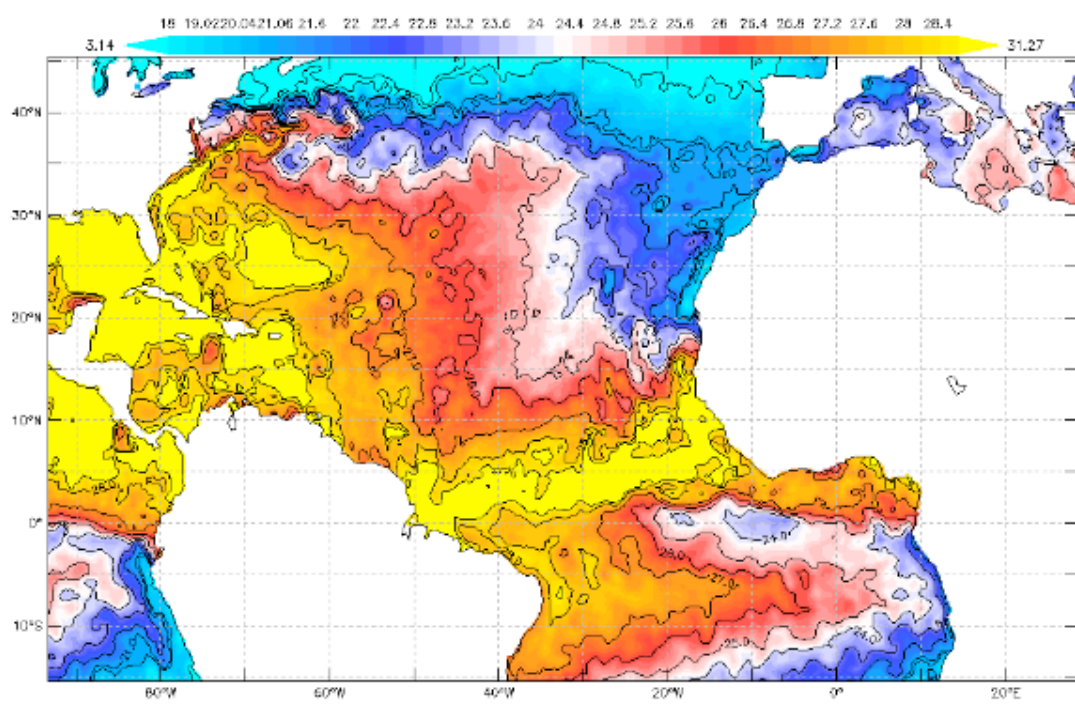
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Plot 2 –Daily Sea Surface Temperature (GHR SST) in degrees Celsius For April 15, 2014



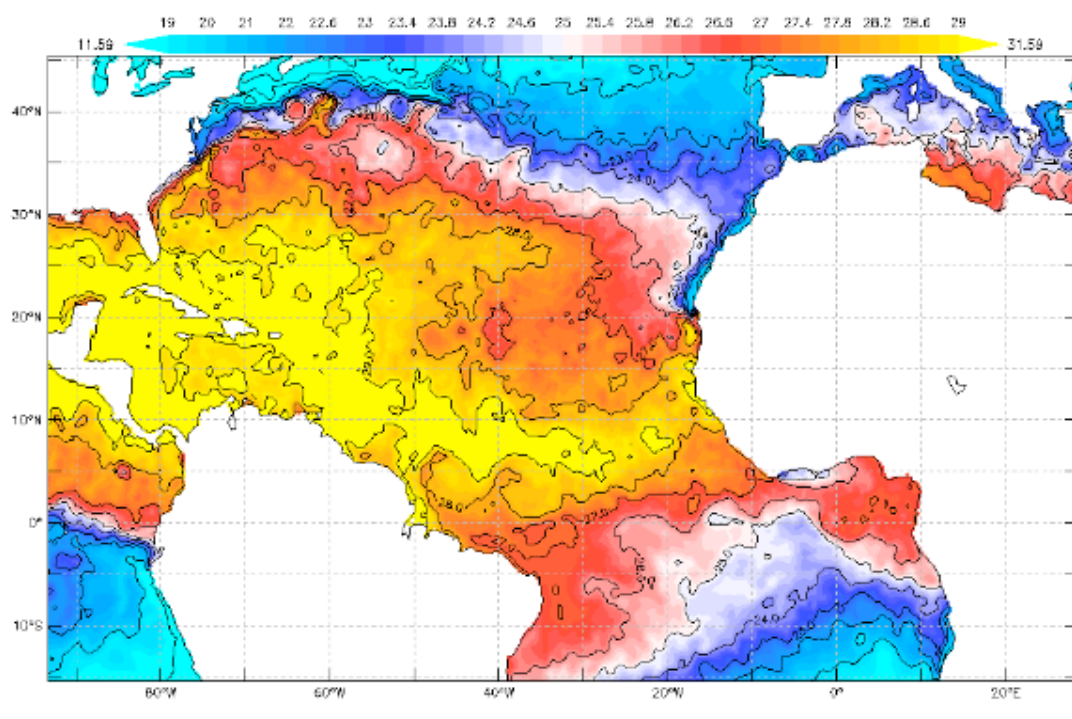
Plot 3 –Daily Sea Surface Temperature (GHR SST) in degrees Celsius For July 15, 2014



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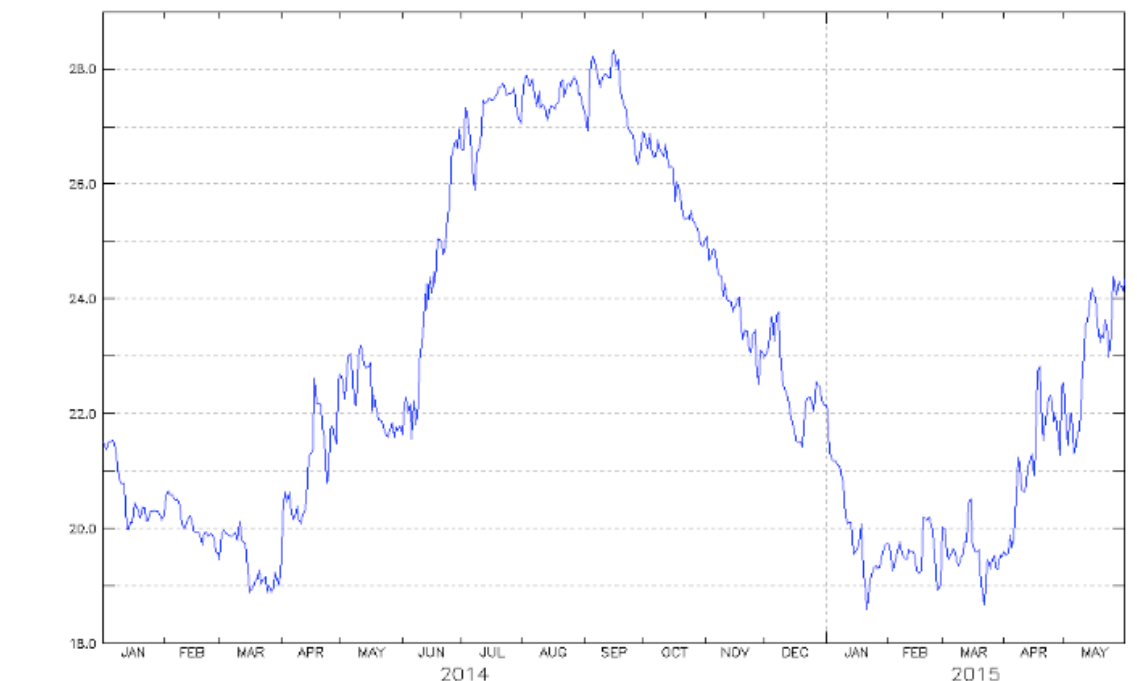
Plot 4 –Daily Sea Surface Temperature (GHR SST) in degrees Celsius For Oct 15, 2014



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Part II: Students will prepare a time series of data for particular location(s) on the Gulf Stream.



Part III: Please refer to the lesson to complete part III of this lesson, as it does not use the LAS to obtain the data.

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Questions:

1. Locate your data position(s) on a map of the Atlantic Ocean. Find the minimum and maximum temperature at your location(s). Compare results for different locations for dates in January, April, July and October. Discuss any major differences in temperature over the course of the year. Is the position of the Gulf Stream changing by season?
2. Can you describe how the sea surface temperature of the Gulf Stream affects the weather along the East Coast and in Europe? How do you think the position of the Gulf Stream may affect offshore operations such as the fishing industry? Do the results agree with your hypotheses?
3. At latitude 45 N, winter temperatures of Bar Harbor, Maine can get as low as -15 C while at Newquay, United Kingdom it can get as low 41 C. Can you draw any conclusions about the difference in climate between western and eastern shores of the North Atlantic Basin?

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Extensions:

Read the article linked above and discuss in class:

1. It is claimed that the Gulf Stream brings mild winter climate to Eastern Europe. Discuss if this is myth or fact, or simply an incomplete explanation.
2. What effects will global warming have on the Gulf Stream? Discuss the climate feedbacks described in the article.